Alaska Energy Authority & Denali Commission
Emerging Energy Technology Fund Progress Report

Grant Number: 7310051

Project Title: Wind-Diesel Battery Hybrid for Kwigillingok

Grantee: Intelligent Energy Systems

Reporting Period: July 1, 2013 to September 30, 2013

Deliverables Submitted: Deliverables from milestone 6 of factory acceptance testing attached. Milestone 1 remains 90% complete and waiting signed site agreement return from the community.

Budget: Project remains on budget and completable as proposed. No reimbursements requested during this reporting period. Reflected in financial progress report. Total expenditures reported to date remain $475,500.00.

Schedule Status: Project milestone 3, 4 and 5 still in progress. Installation of data collection instrumentation postpones completion of full economic analysis and system modeling summary report. Project milestones 3, 4 and 5 are projected to be completed by March 31, 2014. Materials required for installation and commissioning of battery module are on site and awaiting schedule for completion.

Percent Complete: 55% project completion overall.

Milestone	Task		Deliverables	Deliverables
	1	Complete site design	System one-line, site agreement, installation narrative, instrumentation plan	90% Complete
	2	Procure battery and inverter		100% Complete
	3	Install instrumentation and collect baseline data		In progress
	4	Economic analysis	Economic analysis	Initiated
	5	System modeling	Modeling summary report	In progress
	6	Factory acceptance testing	Acceptance test results	100% complete
	7	Procure remaining equipment		90% complete
	8	Deliver materials to site		90% complete
	9	Installation and commissioning	Commissioning report	
	10	Long term monitoring		
	11	Data evaluation and draft project report	Draft project report	
	12	Final project report	Final report	

Work Progress: Battery system shipped and arrived in Kwig. Weather and flooding delayed transport of battery container to installation site until ground is more stable for weight of module.

Foundation and electrical grounding materials installed at site. Awaiting module move to complete electrical connection.

All installation materials on site in preparation for hook-up and commissioning.

Data collection instrumentation procured and awaiting final programming before delivery and installation.

Future Work: Economic analysis and system modeling completion delayed due to data collection equipment requirements. To be done in tandem during next reporting period.

Installation and commissioning of battery module scheduled for 1st quarter 2014, due to supplier availability and weather conditions.

Project remains on budget with no significant completion problems forseen. Delay of milestones due to weather issues, supplier/contractor availability.

QUALITY RECORD

FACTORY TEST PROCEDURE

FAT

260kVA PCS100 ESS

PPMV - ALASKA

Unit S/N: 2UCP190019

Type des.	ESS PCS100		Part no.			
Prep.	/ Dan Wells	06/24/2013	Doc. kind	Test Record		No. of p.
Appr.	/ Erik Martensson	06/24/2013	Title	Factory Test Procedure		16
Resp. dept	8240154	Approved				
ABB			Doc. no.	Lang.	Rev. ind.	Page
			956057-0A1-T	en	0	1

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PRECAUTIONS

USE UTMOST CARE WHEN CONDUCTING THIS TEST PROCEDURE.

CAUTION: CONDUCTIVE FIBERS IN LIGHT BLUE ESD COATS CONDUCT DANGEROUS CURRENTS AT TEST VOLTAGE. REMOVE THESE COATS BEFORE TESTING. USE COTTON COATS INSTEAD.

MAKE SURE THAT THE CABINET IS PROPERLY GROUNDED.

ENSURE POWER IS OFF WHENEVER ADDING OR REMOVING TESTING DEVICES.

ALWAYS VERIFY CONNECTIONS BEFORE APPLYING POWER.

ALWAYS USE EXTREME CAUTION WHEN CABINET DOOR IS OPEN AND POWER IS APPLIED TO UNIT.

AFTER DISCONNECTING THE SUPPLY VOLTAGE WAIT AT LEAST 5 MINUTES AFTER THE LIGHTS OF THE DIGITAL READOUT HAVE GONE OUT BEFORE STARTING ANY WORK IN THE IMMEDIATE VICINITY OF THE MODULE. USE A VOLTMETER TO VERIFY THAT VOLTAGE IS NOT PRESENT.

IF NONSTANDARD EQUIPMENT IS IN UNIT, CONTACT LEAD TESTER OR ENGINEERING BEFORE TESTING.

PRIOR TO PERFORMING THE FUNCTIONAL TEST A PERSON SHOULD HAVE A BASIC UNDERSTANDING OF PROGRAMMING AC INVERTERS.

1. GENERAL ASSEMBLY REQUIREMENTS

- ❑ All the connectors need to be fully seated and engaged
- ❑ Shrink tubing protecting all high voltage connections MUST be transparent in order to see and inspect the red torque mark. Red mark below the transparent shrink tubing must be visible.
- ❑ All components need to be installed correctly on the DIN rails and secured by appropriate hardware.
- ❑ All the cables must be routed in order to avoid any unusual bending and overstress on wire, pins and connectors.
- ❑ All power connections and connectors need to be color marked as sign of inspection and correct torque. Torque marks need to come across different hardware: PLATE–WASHER–NUT–HEAD OF THE SCREW. Double check mark is suggested on critical torque.
- ❑ All the cable assembly needs to follow IPC 620 standards as well as manufacture recommendations. Pins of correct size for the wire and proper crimping process should be used.
- ❑ Loose hardware (¼ 20, washers, nuts…), plastic junk and scraps are not allowed into the cabinets.
- ❑ All the adhesive wire ties need to secure the wires without pulling or peeling off from the surface for the entire life of the product
- ❑ Cabinet and enclosure doors must open-close freely.

2. GENERAL TEST INSTRUCTION

1.1. Record all failures during testing on test report with corrective actions taken or to be made. Use the form located at the end of this document.

1.2. Refer to special test instructions issued by engineering for nonstandard equipment testing if required.

1.3. Please enter the dates during which these tests were performed:

START DATE OF TESTING	06/19/2013
END DATE OF TESTING	06/21/2013

NOTE: Tests are not necessarily performed in the sequence mentioned herein! This test procedure may be modified and expanded to better fit system requirements, based on actual site equipment that is tied into the PCS100 ESS unit.

3. DESIGN REFERENCE DOCUMENTS

The following project documents will be provided for testing. The tester should refer to the project documents not listed below as needed.

3AUP000A112-R	Single Line Diagram
3AUP000A112-S	Schematic Diagram
The latest revision of:	PCS User and Commissioning Manual.
3AUP005A112	ESS Client Remote Interface Instructions
2UCD190000E001_PB1	PCS100 ESS User Manual
2UCD190000E002_c	PCS100 ESS Technical Catalogue2
2UCD200000E001_a	How to View the GDM Web Pages

4. TEST EQUIPMENT AND TEST SOFTWARE REQUIREMENTS

Following tools will be provided for the test. **Note: Depending on testing, more or less equipment may be required.**

Item	Suggested Equipment	Type	Quantity	Calibration Date
1	Tool Box with hand tools	various	As needed	
2	Test leads	various	As needed	
3	Digital Multimeter		1	

4	Clamp on Ammeter 600A		1	

Item	Software	Version Used For Testing
1	ABB PLC Control Builder AC800M	V5.1.0/1
2	Panel Builder 800	V5.1/0
3	Standard PC software	Various

5. INITIAL INSPECTION

	INSTRUCTION	COMPLETED / INITIALS	COMMENTS
5.1	Make a complete visual check of assemblies for damaged components, cabinets, etc.	☒ DW	
5.2	Check bus bar connections for proper tightness of bolted connections and adequate clearance	☒ DW	
5.3	Check cables connections for proper tightness of bolted connections and adequate clearance	☒ DW	

6. MECHANICAL INSPECTION

	INSTRUCTION	COMPLETED / INITIALS	COMMENTS
6.1	Make louvers inspection - Installation - sealing	☒ DW	
6.2	Inspect doors for proper sealing and locking	☒ DW	
6.3	Inspect: - cable bus bar connections	☒ DW	
6.4	Inspect bolted connections: - all equipment and brackets are in place - all equipment is bolted properly Note any missing bolts, screws and missing hardware	☒ DW	
6.5	Inspect PCS100 ESS enclosure: - paint - dents - any damages	☒ DW	

7. GROUND CONNECTION CHECK AND WIRING CHECK

Connect enclosure to building/test ground.

	INSTRUCTION	COMPLETED / INITIALS	COMMENTS
7.1	Verify that enclosure is properly grounded	☒ DW	

	INSTRUCTION	COMPLETED / INITIALS	COMMENTS
7.3	Perform a complete continuity test on all wiring - refer to schematic diagram 3AUP000A112-S. Check wiring per schematic drawings.	☒ DW	

8. PROTECTION AND SETTING

8.1 Breaker protection setting

	INSTRUCTION	COMPLETED / INITIALS	COMMENTS
8.1.1	Adjust PR221 protection unit settings for CB022A. – This will be done on site during commissioning/stat-up with correct system information.	☐ _____	This will be done during commissioning

9. AUXILLARY POWER & MAIN POWER

9.1 Preparation to power up

Test 120VAC, auxiliary power source will be temporarily connected to the PCS100 cabinet. Connect 120VAC, 20A, 60Hz aux power to Line terminals TBC(1,2,3). Use 12Awg wire for connections. All power distribution shall be verified against schematic diagram 3AUP000A112-S.

	PREPARATION	COMPLETED / INITIALS	COMMENTS
9.1..1	Open all circuit breakers in the PCS100 cabinet	☒ DW	

9.2 Auxiliary power - Verification and power up

	INSTRUCTION – AUX POWER – 120VAC	COMPLETED / INITIALS	COMMENTS
9.2.1	Power up test facility auxiliary feed and verify 120VAC, and ensure proper operation of APC UPS - Voltage shall be +/-10% of nominal value. If voltage is within tolerance close circuit breakers (CB050A, CB050B, and CB050C)	☒ DW	
9.2.2	Verify 120VAC power distribution	☒ DW	
9.2.3	Verify 24VDC power distribution	☒ DW	

10. SOFTWARE LOADING AND FIRMWARE RECORDS

10.1 Control cabinet PLC

	INSTRUCTION	COMPLETED / INITIALS	COMMENTS
10.1.1	Load project application software in the AC800M PLC / (PM051A) Record: Firmware version: ___5.1.100.13_____ Project application version:___c956057_20130621_____	☒ DW	
10.1.2	Verify AC800M IP address & subnet mask IP: 172.16.0.200 Subnet mask:255.255.255.0	☒ DW	
10.1.3	Record CI867 IP address IP: __172.16.0.215_____ Subnet mask : ____255.255.255.0_____	☒ DW	

10.2 Process panel

	INSTRUCTION	COMPLETED / INITIALS	COMMENTS
10.2.1	Load project application software in the PP835 / (A066A). Record: Firmware version: ____V4.0/0 B211.1.1_____ Project application version:___956057_2013_06_22.pba_____	☒ DW	
10.2.2	Verify PP835 IP address & subnet mask IP: 172.16.0.101 Subnet mask:255.255.255.0	☒ DW	

11. INVERTER SYSTEM SETUP

For detail instruction how to set up PCS100 ESS inverter system refer to PCS100 ESS User and Commissioning Manual.

	INSTRUCTION	COMPLETED / INITIALS	COMMENTS
11.1	Load master with latest firmware. Record firmware version R2H2	☒ DW	
11.2	Set GDM IP Address and IP Mask. Record values: IP: 172.16.0.210 Subnet mask:255.255.255.0	☒ DW	

11.3	Set and record serial communication parameters 40 Modbus Address:10 41 RS-485 Baud Rate:19200 42 RS-485 Parity:even 43 RS-485 Timeout:0	☒ DW	
11.4	Set/Verify: - Set/Verify site specific data - System Electrical Menu Values for factory test - Set/Verify Mode Selector Values - Set Statcom Configuration Parameters - Set/Verify Voltage and current feedback values	☒ DW	
11.5	Save service log. Record service log file name: Service_956057_Alaska_FAT	☒ DW	

12. INTERNAL SYSTEM COMMUNICATION VERIFICATION

	INSTRUCTION	COMPLETED / INITIALS	COMMENTS
12.1	Verify Ethernet communication between PM051A (AC800M) and PP835 (A066A), as well as all other devices tied into ESW065A	☒ DW	
12.2	Verify Modbus communication between PM051A through A053A (RS-232/RS485 Converter) and PCS100 (Inverter Master)	☒ DW	

13. 480VAC FUNCTIONAL TEST – SOAK TEST

This test is performed by applying full voltage power to the system. During the test only minor power will be absorbed from the grid. This test circulates real and/or reactive current between the inverter modules. Batteries are not required for this test and even if available will not be connected.

	SYSTEM PREPARATION	completed / initials
13.1	Remove all temporary and test leads.	☒ DW
13.2	Remove all temporary system grounds	☒ DW
13.3	Load the latest SW and set all SW parameters for the normal operation	☒ DW
13.4	Connect 480VAC to the system. Close CB022A, and verify voltage.	☒ DW
13.5	Verify that all PCS100 inverter and Master modules are operational	☒ DW
13.6	Verify that the system is stopped	☒ DW
13.7	Test engineer has to log in to the PCS100 system as Tech (for more details refer to the PCS User's Manual.	☒ DW
13.8	Using ABB commissioning PC (interactive windows) close AC breaker CB022A.	☒ DW

Two test modes are available to soak the PCS100 system without batteries. The selection of the test modes should be changed only when system is stopped.

MODE NAME	TEST	REFERENCE
AC Soak – no bat	Circulates reactive current between the inverter modules. No DC source required.	29 AC Soak I Reactive: Reactive current reference between modules.
DC Soak – no bat	Circulates real and/or reactive current between the inverter modules. No DC source required.	29 AC Soak I Reactive: Reactive current reference between modules. 28 DC Soak I Real: Real current reference between modules.

Table 1

It is recommended to run system in both test modes starting with AC soak test.

	TO RUN TEST	completed / initials
13.9	On the GDM Control Panel: **1 – PRESS MENU.** **2 - PRESS HOME MENU** **3 - SELECT COMMISSIONING** *Result: A list of menu items is displayed.* **4 – PRESS 20 INVERTER MODE** *Result: A numeric keypad is displayed. The date and time is displayed.* **5 - SELECT THE DESIRED TEST MODE FROM THE LIST** *Note: The test mode will be selected.*	☒ DW
13.10	Start the system	☒ DW
13.11	Adjust the References for the specific mode (Reference parameters are listed in the table 1).	☒ DW

14. TEST NOTES

Notes and Special Test Records:

15. REVISIONS:

REVISIONS TABLE

REV IND	DATE	DESCRIPTION	REV BY
0	06/24/2013	INITIAL RELEASE	DW

Test Report

Date : 2013.11.01

Approval items	■ Appearance □ Size □ Material(MS) ■ Performance(ES)						Approval		
Part Name	UPB4860 Pack	Supplier	LG Chem Advanced Battery Division				Prepared	Reviewed	Approved
Part Number	-	EO No	-			Consumer			
Model	ESS Standard					Supplier			

No.	Test Items	Criteria	Supplier						Consumer					
			X1	X2	X3	X4	X5	Pass/Fail	X1	X2	X3	X4	X5	Pass/Fail
1	Visual inspection	-	OK	OK	OK	OK	OK	Pass						
2	Voltage													
3	Pack voltage	50.54V≤V≤51.10V	50.94	50.9	50.9	50.92	50.91	Pass						
	Cell voltage(Refer to "Data" sheet)	3.61V≤V≤3.65V	OK	OK	OK	OK	OK	Pass						
	Insulation resistance(Refer to "Data" sheet)	X > 5MΩ	OK	OK	OK	OK	OK	Pass						
4	DCIR													
	Pack DCIR	13.34mΩ < X < 17.84mΩ	14.32	13.8	13.82	13.57	14.41	Pass						
	Cell DCIR(Refer to "Data" sheet)	0.727mΩ < X < 1.349mΩ	OK	OK	OK	OK	OK	Pass						
5	Module voltage difference between measurement result and BMS output	ΔV≤210mV	99	82	131	118	113	Pass						
6	Voltage deviation between cells in pack	ΔV≤45mV	11	13.4	12.2	13.4	18.3	Pass						
7	Pack temperatue(Refer to "Data" sheet)	ΔV≤4℃	OK	OK	OK	OK	OK	Pass						

Remark

Basic Inspection

□ Part Name	UPB4860	□ Site	LGChem
□ Inspection Date	2013.04.06~07		

No.	Pack ID	Visual inspection	Voltage(V)			Insulation resistance	DCIR(mΩ)			Pack voltage difference (mV)	Voltage deviation (mV)	Pack temp.(℃)			Remark
			Pack	Cell(Max)	Cell(min)		Pack	Cell(Max)	Cell(min)			Temp.1	Temp.2	Ambient	
1	UPB4860BMAT71304070001	OK	50.94	3.65	3.64	OK	14.32	1.04	0.88	99	11.0	26.1	25.9	25.9	
2	UPB4860BMAT71304070002	OK	50.94	3.65	3.64	OK	13.80	1.05	0.87	82	13.4	26.1	26.1	25.9	
3	UPB4860BMAT71304070003	OK	50.90	3.65	3.64	OK	13.82	1.03	0.90	131	12.2	25.8	25.7	25.7	
4	UPB4860BMAT71304070004	OK	50.92	3.65	3.64	OK	13.57	1.01	0.90	118	13.4	25.7	25.7	25.9	
5	UPB4860BMAT71304070005	OK	50.91	3.65	3.64	OK	14.41	1.04	0.91	113	18.3	25.1	25.1	26.3	
6	UPB4860BMAT71304070006	OK	50.92	3.65	3.64	OK	14.24	0.99	0.90	110	12.2	25.6	25.7	25.9	
7	UPB4860BMAT71304070007	OK	50.92	3.65	3.64	OK	14.83	1.03	0.88	130	11.0	26.0	26.2	26.0	
8	UPB4860BMAT71304070008	OK	50.92	3.65	3.64	OK	14.32	1.10	0.89	105	11.0	25.9	25.7	26.1	
9	UPB4860BMAT71304070009	OK	50.92	3.65	3.64	OK	14.78	0.99	0.88	122	12.2	26.1	26.0	26.0	
10	UPB4860BMAT71304070010	OK	50.92	3.65	3.64	OK	14.42	1.10	0.88	119	9.8	26.1	26.0	26.0	
11	UPB4860BMAT71304070011	OK	50.92	3.65	3.64	OK	14.61	1.05	0.88	122	11.0	26.2	26.2	26.1	
12	UPB4860BMAT71304070012	OK	50.92	3.65	3.64	OK	14.91	0.98	0.88	104	11.0	26.1	26.2	26.1	
13	UPB4860BMAT71304070013	OK	50.92	3.65	3.64	OK	14.72	1.17	0.89	112	9.8	26.2	26.1	26.0	
14	UPB4860BMAT71304070014	OK	50.92	3.65	3.64	OK	14.14	1.03	0.88	110	11.0	25.8	26.1	26.2	
15	UPB4860BMAT71304070015	OK	50.93	3.65	3.64	OK	14.60	1.04	0.89	105	13.4	26.0	26.2	26.0	
16	UPB4860BMAT71304070016	OK	50.93	3.65	3.64	OK	14.07	1.02	0.89	98	9.8	25.9	26.0	26.0	
17	UPB4860BMAT71304070017	OK	50.93	3.65	3.64	OK	14.31	1.13	0.88	96	12.2	26.0	26.2	26.2	
18	UPB4860BMAT71304070018	OK	50.92	3.65	3.64	OK	14.03	1.09	0.86	119	9.8	26.1	26.1	26.2	
19	UPB4860BMAT71304070019	OK	50.93	3.65	3.64	OK	14.18	1.03	0.87	95	13.4	26.3	26.4	26.2	
20	UPB4860BMAT71304070020	OK	50.93	3.65	3.64	OK	14.16	1.04	0.87	109	11.0	26.1	26.1	26.3	

No.	Pack ID	Visual inspection	Voltage(V)			Insulation resistance	DCIR(mΩ)			Pack voltage difference (mV)	Voltage deviation (mV)	Pack temp.(℃)			Remark
			Pack	Cell(Max)	Cell(min)		Pack	Cell(Max)	Cell(min)			Temp.1	Temp.2	Ambient	
21	UPB4860BMAT71304060126	OK	50.93	3.65	3.64	OK	14.01	1.06	0.85	109	12.2	26.4	26.3	26.0	
22	UPB4860BMAT71304060127	OK	50.92	3.65	3.64	OK	14.09	1.07	0.87	111	9.8	26.4	26.4	26.0	
23	UPB4860BMAT71304060128	OK	50.91	3.65	3.64	OK	13.64	1.01	0.88	132	11.0	25.0	25.4	25.8	
24	UPB4860BMAT71304060129	OK	50.93	3.65	3.64	OK	13.76	1.14	0.86	79	9.8	26.4	26.4	26.0	
25	UPB4860BMAT71304060130	OK	50.93	3.65	3.64	OK	13.68	1.01	0.87	137	12.2	26.3	26.3	25.9	
26	UPB4860BMAT71304060131	OK	50.94	3.65	3.64	OK	13.79	1.12	0.88	97	13.4	26.3	26.3	26.0	
27	UPB4860BMAT71304060132	OK	50.94	3.65	3.64	OK	13.75	1.00	0.88	123	11.0	26.3	25.9	25.9	
28	UPB4860BMAT71304060133	OK	50.94	3.65	3.64	OK	13.82	1.03	0.86	105	12.2	26.2	26.1	26.0	
29	UPB4860BMAT71304060134	OK	50.94	3.65	3.64	OK	13.60	0.99	0.89	102	14.7	26.2	26.0	26.0	
30	UPB4860BMAT71304060135	OK	50.94	3.65	3.64	OK	13.84	0.96	0.87	98	11.0	26.2	26.1	26.0	
31	UPB4860BMAT71304060136	OK	50.93	3.65	3.64	OK	13.47	0.96	0.88	134	13.4	26.3	26.2	25.7	
32	UPB4860BMAT71304060137	OK	50.93	3.65	3.63	OK	13.77	1.10	0.88	71	17.1	26.2	26.1	26.0	
33	UPB4860BMAT71304060138	OK	50.94	3.65	3.64	OK	13.64	1.04	0.88	107	12.2	26.1	26.1	25.8	
34	UPB4860BMAT71304060139	OK	50.94	3.65	3.64	OK	14.05	1.02	0.87	108	12.2	26.1	26.1	25.7	
35	UPB4860BMAT71304060140	OK	50.93	3.65	3.64	OK	14.28	1.16	0.88	103	11.0	26.1	26.1	25.8	
36	UPB4860BMAT71304060141	OK	50.94	3.65	3.64	OK	14.21	1.01	0.87	82	12.2	26.3	26.1	26.0	
37	UPB4860BMAT71304060142	OK	50.93	3.65	3.64	OK	13.53	0.95	0.89	112	9.8	26.2	26.1	26.0	
38	UPB4860BMAT71304060143	OK	50.93	3.65	3.64	OK	13.66	1.01	0.85	118	12.2	26.4	26.2	26.1	
39	UPB4860BMAT71304060144	OK	50.94	3.65	3.64	OK	13.53	1.00	0.89	88	15.9	26.0	25.8	26.0	
40	UPB4860BMAT71304060145	OK	50.94	3.65	3.64	OK	13.68	1.06	0.88	115	13.4	26.2	25.9	25.8	
41	UPB4860BMAT71304060146	OK	50.93	3.65	3.64	OK	13.39	0.98	0.87	102	12.2	26.1	26.1	25.9	
42	UPB4860BMAT71304060147	OK	50.94	3.65	3.64	OK	13.59	1.07	0.88	116	12.2	26.1	25.9	26.0	